UNHOLTZ-DICKIE CORPORATION

vibration generation systems and measurement instruments

INSTRUCTION MANUAL
ACS-6 SN 107

OUTLINE OF PRODUCTS

I. Vibration Test Systems, with 2 Year Warranty on Shaker Moving Element and Suspension

Our line of shaker systems covers the range of 150 pounds to 8000 pounds force, with multi-shaker systems for larger loads, and custom designed systems for natural mode vibration tests.

Series 70 Systems, 150 to 450 force pounds for components, general use in small laboratories, and studies of dynamic response in larger structures.

Series 80 Systems cover the range of 1200 to 3200 pounds, with popular models at 1200, 1600, 2000, 2500 and 3000 pounds force.

Series 90 Systems from 3000 to 6000 pounds force with a 4000 pound all air cooled system developed for excellent performance and highest reliability.

Series 1000 Systems for large loads, multi-shaker arrays and driving large slip tables.

Special Systems for low frequency, long stroke, and other unusual applications.

Complete engineering specifications of systems with air or water cooling, solid-state or tube type amplifiers, massive or lightweight armatures are available on request. Popular systems are listed in tabular form in the bulletins.

II. Vibration Calibration Systems

Featuring 100 g acceleration to 10 kHz with lowest acceleration distortion and cross axis motion available. Instrumentation allows rapid and accurate manual calibration of accelerometers or velocity pickups with direct digital indication of sensitivity. No calculations of any kind are required. Precision instrumentation includes automatic plotting of voltage, charge and capacitance variations vs frequency. A complete separate catalog on systems and instruments is available.

The DO-5000 Digital Optical Vibration Sensor for absolute measurement of displacement is offered to calibrate the reference measurement channel to 0.1% accuracy.

Thermal accessories for a wide range of temperature calibration is offered.

(Continued inside back cover)

OPERATING AND SERVICING INSTRUCTIONS

UNHOLTZ-DICKIE MODEL ACS SERIES

ACCELERATION CONTROL SELECTOR

MODEL ACS-6

SERIAL NO. 107

Unholtz-Dickie Corporation
2994 Whitney Avenue
Hamden, Connecticut 06518

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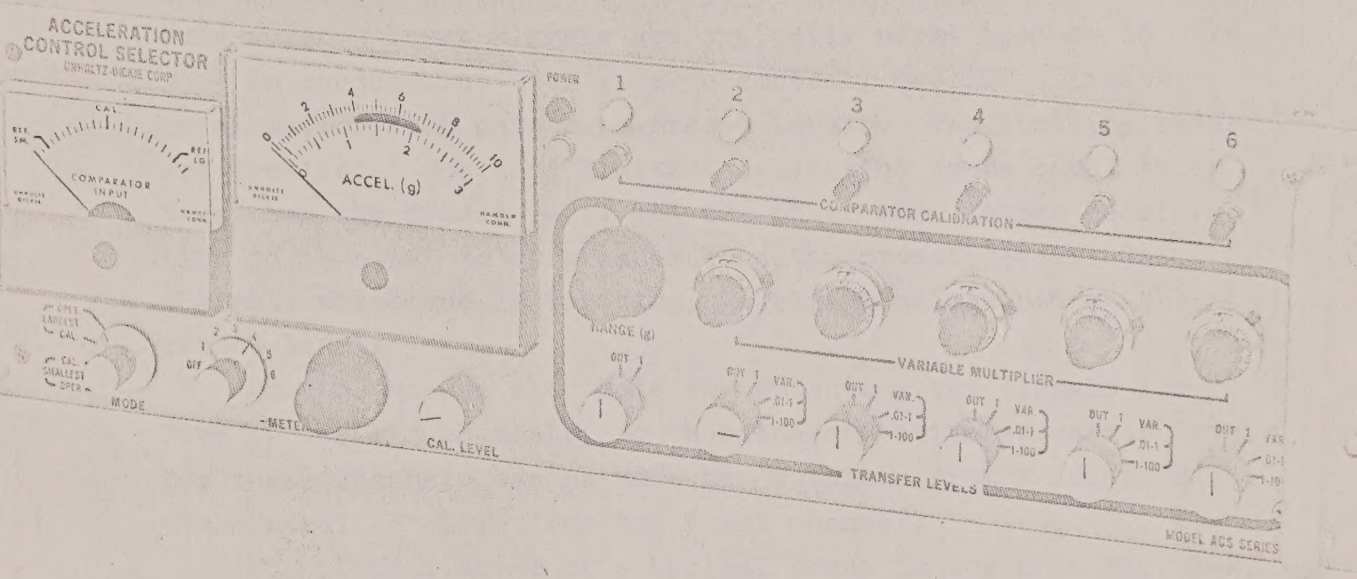


Features

- Selects either the largest or smallest of six acceleration signals
- Variable weighting for having independent selection levels for each channel
- Detection time varies continuously with frequency and is as fast or faster than closed-loop servo response time
- Visual indication of control channel
- Provisions for accurately presetting the selection or switching levels
- Switch interlock circuitry in the event of operator error
- Large, accurate vibration meter with single-ended dc output
- All solid state signal switching

1. INTRODUCTION

The Unholtz-Dickie Model ACS-6 Series Acceleration Control Selector is a solid-state device for selecting one acceleration signal from as many as six signals to provide control for a sine-vibration test. It is compatible with any standard amplitude servo. Input signals are typically normalized to 10 mV/g.

In conjunction with a servo control, the ACS-6 limits acceleration at 6 points to preset levels. Two limiting modes are provided. One mode limits acceleration to be equal to or less than the preset level and the other mode forces acceleration to be equal to or greater than the preset level. One channel, whichever is limiting, is always maintained at the preset level.

Provisions are also made for weighting the signals for five of the six channels, so that the effective selection levels for these channels can be made any multiple from x .01 to x 10.0 the control level set for the first channel.

The block diagram of a typical setup is shown in Fig. 1-2.

The ACS-6 accepts as many as six acceleration signals from standard signal-conditioning amplifiers. Each is weighted according to the front panel control settings and is applied to a six-channel gate circuit. Each weighted input voltage is also converted to a dc voltage which is presented to a six-channel comparator circuit. The comparator circuit then triggers the gate associated with the largest (or the smallest) signal presented. A light indicates the active or gated signal channel. The desired input acceleration is thereby gated to the servo for control purposes.

A dc voltage from the sweep oscillator which is proportional to log frequency is used to control the filter time constant of of the AC-DC converters in the ACS-6. The time constant so obtained is very nearly equal to the closed-loop response time of a servo which has 10 dB/sec (compressor speed at 5 Hz increasing to 3000 dB/sec at 5 kHz. Thus, the inputs to the comparator circuit follow the dynamic changes of the amplitudes of the

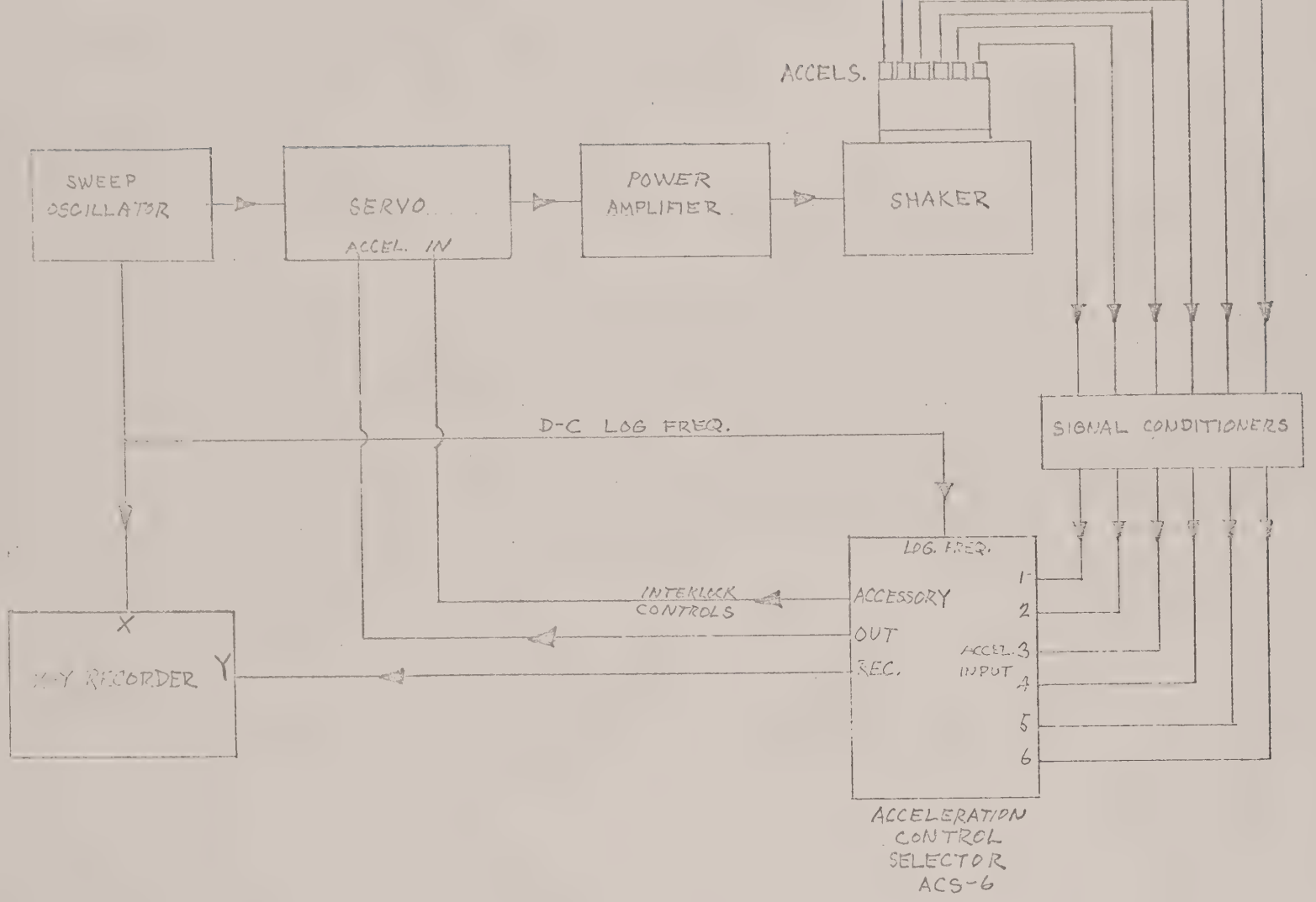


Fig 1-2

TYPICAL TEST SETUP BK OR UD SERVO

sine accelerations as well or better than the servo can follow the dynamic gain changes of the control channel.

For purposes of calibrating and presetting the comparator circuit, a front panel switch inserts a variable-amplitude power frequency signal to all acceleration inputs. This enables the front panel controls to be completely adjusted prior to the actual test. In the calibration mode the servo is automatically kept in a standby or fully compressed condition.

Furthermore, if an attempt is made to change any switch setting inside the TRANSFER LEVELS rectangle while an actual vibration test is being carried out, the ACS-6 will automatically return the servo to the standby or fully compressed condition.

All signal switching is accomplished by solid-state devices. The circuitry is located on printed-circuit plug-in cards for reliability, accessibility and ease of maintenance.

2. DESCRIPTION OF CONTROLS AND CONNECTORS

2.1 The red POWER light goes on when power is applied to the ACS-6 through the line cord. There is no switch so the instrument cannot be turned off inadvertently. If the POWER light does not turn on, but the chassis fan does operate, the 5.5V relay power supply should be checked, since the light derives its power from this supply.

2.2 The yellow STANDBY light located just beneath the POWER light goes on if the instrument is plugged in while the MODE switch is in either OPER. mode. To turn it off and reset the interlock circuit, return the MODE switch to either CAL position and then to the OPER. mode. If the position of any switch within the TRANSFER LEVELS rectangle is changed when the MODE switch is in either OPER. condition, the STANDBY light goes on. For use with B&K servos a negative voltage is applied to the compressor section whenever the STANDBY light is on.

2.3 The MODE switch has four positions, each of which is described below:

2.3.1 OPERATE-LARGEST: The largest of the weighted signals applied to the ACCEL inputs is gated to the OUTPUT. As a signal increases in amplitude for a particular channel selected by the METER SELECTOR, the meter indication on the COMPARATOR INPUT moves from right to left (downscale).

2.3.2 CALIBRATE-LARGEST: A power-frequency signal of adjustable amplitude is fed to all acceleration inputs. The ACCELERATION meter indicates the amplitude of this signal and adjustment of other front panel controls allows complete presetting of the switching levels for operation in the LARGEST selection mode.

2.3.3 CALIBRATE-SMALLEST: Same description as 2.3.2 except that presetting is accomplished for operation in the SMALLEST selection mode.

2.3.4 OPERATE-SMALLEST: The smallest of the weighted signals applied to the ACCEL input is gated to the OUTPUT. An increase in signal amplitude causes the COMPARATOR INPUT indication to move from left to right (upscale).

2.4 The METER SELECTOR switch is located to the right of the MODE switch. It allows the ACCEL (g) meter to monitor the amplitude of the acceleration of the indicated channel, and allows the COMPARATOR INPUT meter to monitor the voltage presented to the comparator circuit by the channel indicated.

2.5 The COMPARATOR INPUT meter is buffered by an emitter follower to prevent loading of the comparator input circuit. With zero input signal, and the MODE switch in either OPER or CAL LARGEST position, the indication should be REF. LG. (at right). With zero input for the OPER. or CAL. SMALLEST positions, the indication should be REF. SM. (at left). For optimum operation, channel switching should be accomplished for signals large enough to cause an indication at or near the CAL. mark.

2.6 The METER RANGE switch selects the full-scale range of the ACCEL. meter. This switch is not interlocked in the OPER. modes since it provides a monitoring function only.

2.7 The CAL. LEVEL potentiometer derives a power frequency voltage from the power transformer and applies it to all six ACCEL inputs simultaneously in either CAL. mode. In the CAL. modes the external inputs are disconnected. The CAL. LEVEL control has a logarithmic characteristic so that acceleration levels from 0.3 g to 1000 g can be simulated.

2.8 The COMPARATOR RANGE switch is located inside the rectangle in the channel 1 position. It gives the maximum value for the switching level for channel 1 and a related value for the switching levels for the remainder of the channels.

2.9 The MULTIPLIER switches are located inside the rectangle. In the OUT position the channel is inactive, the input is grounded and the COMPARATOR input is held at the REF. LG. position to prohibit switching to the inactive channel.

The UNITY (1) position indicates that the weighting of the input signal is unity (gain is unity) and that the switching level is the same as that set for Channel 1 (the control channel).

The VARIABLE positions of the MULTIPLIER switch for channels 2 through 6 indicate the ranges over which the switching level of Channel 1 may be multiplied in order to obtain the switching level of the indicated channel. The .01 - 1 range indicates a multiplier from .01 to 1 and a corresponding gain range of the input amplifier from 100 to 1. The 1 - 10 range indicates the level multiplication factor and a corresponding gain range for the input amplifier of 1 to 0.1.

The multiplier range less than unity would have application for limiting cross-axis motion, since cross-axis motion is generally smaller (or should be) than that in the primary control channel. The multiplier range greater than unity would have application for limiting the acceleration of resonant points on the specimen, since magnification factors much greater than unity relative to the control point are often realized.

2.10 The VARIABLE MULTIPLIER controls for Channels 2 through 6 are precision ten-turn potentiometers, the dials of which are offset slightly less than 0.1 turn. The dial setting gives a precision indication of the multiplier for each multiplier gain range. The table below summarizes this information.

MULTIPLIER RANGE	MULTIPLIER	GAIN VAR. GAIN AMP.
1	dial not active	1
.01 - 1	0.1 x (dial setting)	$\frac{10}{\text{(dial setting)}}$
1 - 10	1.0 x (dial setting)	$\frac{1}{\text{(dial setting)}}$

2.11 The COMPARATOR CALIBRATION potentiometers normalize the outputs of each AC-DC converter circuit. The adjustment is made so that acceleration signals equal to the desired selection levels in each channel give identical deflections (to the CAL mark) on the COMPARATOR INPUT METER.

2.12 The CHANNEL INDICATOR lights (white) indicate which channel input is being gated to the output.

2.13 Rear Chassis Connectors and Controls

2.13.1 The ACCEL inputs are provided by six insulated BNC connectors near the bottom edge of the chassis. These accept signals from commercial signal conditioners at a sensitivity of 10 mV/g.

2.13.2 The OUTPUT connector (insulated BNC) supplies the weighted and gated input signal to the acceleration input of the servo. The sensitivity of the output signal is 10 mV/g if the channel multiplier (sec. 2.9 and 2.10) is unity. For other mulitplier values (channels 2 through 6) the output signal sensitivity is 10/multiplier mV/g. The output sensitivity for the channel 1 signal when gated to the output is thus always 10 mV/g.

2.13.3 The LOG FREQ. input connector (insulated BNC) accepts a DC signal proportional to the logarithm of the signal frequency. This signal is generally obtained from the sweep oscillator. The ACS-6 has provisions for accepting either positive-going or negative-going signals up to a maximum value of 10V at 5 kHz. The voltage should be nearly zero at 5 Hz.

2.13.4 The FOUR-POSITION SWITCH to the left of J3 allows the type of inputs suggested in 2.13.3 to be accommodated. A summary appears in the table below:

2.13.4 (continued)

SW. Pos.	ALLOWABLE INPUT VOLTAGE	INSTRUMENT AND SETTING
1	0 to 1.2V	SD104A-5 Freq. Mult. x 1 (5 to 5000 Hz) SD104A-1 Freq. Mult. x 10 (10 to 10,000 Hz)
2	0 to 1.2V	SD104A-5 Freq. Mult. x 0.1 (.5 to 500 Hz) SD104A-1 Freq. Mult. x 1.0 (1 to 1000 Hz)
3	0 to +10V	BK 1018, 1019, 1025 with positive log freq outputs Unholtz-Dickie LFC-5 (0 to 3V) Adjust Potentiometer for +1.2V DC at J3 Pin 5 for 5 kHz input
4	0 to -10V	BK 1025 with standard negative log-freq. output Adjust Potentiometer for +1.2V DC at J3 Pin 5 for 5 kHz input

The adjustability in switch positions 3 and 4 is provided by a TRIMPOT located to the left of the switch. A test point is available at J3-terminal 5 to allow the potentiometer to be adjusted properly.

In all cases, the ACS-6 is calibrated so that 0 volts appearing at J3-5 corresponds to 5/10 Hz and +1.2 volt corresponds to 5/10 kHz. For use with the BK 1018, 1019 or 1025 or the U-D LFC-5, the potentiometer should be adjusted so that the voltage-frequency relation at J3-5 is satisfied.

2.13.5 The RECORDER connector (insulated BNC) provides a single-ended DC voltage proportional to the indication of the ACCEL meter. Full scale meter indication corresponds to +1.00V. The output impedance is 1K and the linearity is better than $\pm$ .005V.

Thus, the input signal for any channel may be recorded by means of the METER SELECTOR SWITCH.

2.13.6 The ACCEL-AUTO DA Switch allows the ACS-6 to be used with a BK 1018/1019/1025 or a U-D Model SP Series

2.13.6 (continued)

Servo for two segment displacement-acceleration programs. In the ACCEL. position the ACS-6 should be used for a constant-acceleration program over the entire frequency range (selection levels are fixed).

2.13.6 (continued)

In the AUTO D-A position, a low-frequency displacement program may be added. For the constant-acceleration portion of the program, the ACS-6 will gate the input signals according to the preset switching levels and the MODE of operation. However, below the crossover frequency, control switches automatically to Channel 1 and a decrease in signal level due to the displacement program cannot cause spurious gating to another channel.

2.13.7 The ACCESSORY connector has several functions:

Pins 1 and 6 are connected to a relay coil and accept the output from the crossover switch in the BK 1018/1019/1025. The relay action causes the AUTO D-A operation described in 2.13.6. Pin 6 is reference or ground.

Pin 5 supplies a voltage for checking the LOG. FREQ. calibration See 2.13.4.

Pin 4 supplies -9V through 3.3 K whenever the ACS-6 is in a CAL mode or if the interlock has been actuated while in an OPER. mode. The voltage is applied to pin 4 of the COMPRESSOR jack in the BK 1018/1019/1025 to provide full compression of the servo.

2.13.8 The INTERLOCK connector provides connections for external interlock circuits. Pins 1 and 2 are shorted by an internal jumper. Removal of the jumper and connection to external normally-closed contacts will provide interlock action whenever the external contacts are momentarily opened.

2.13.9 The INT-EXT switch provides a chassis connection for the signal reference when the switch is in the INT position. The INT position is normally used for bench checkout. The EXT. position is normally used in console operation where it is assumed that the signal reference and console frame are made common in some other instrument.

2.13.10 The FUSE is 1A for a 115V line and 0.5 A for a 230V line. Accommodation for a different line voltage is accomplished by changing the jumpers on a terminal strip inside the chassis near the fuse holder.

3. OPERATION

3.1 Connect instruments as shown in Fig. 1-2. Connect special cable from ACCESSORY connector (J3), to Relay Control B connector and Compressor connector on the BK 1019/1025.

3.2 Calibrate the output at J3 pin 5 according to 2.13.3 and 2.13.4. Allow SD104 oscillator 1 to 2 hours warmup time if used.

3.3 Initial control settings are as follows:

MODE	-	CAL (LARGEST or SMALLEST as desired)
METERS	-	OFF and 1000 g
COMPARATOR RANGE	-	1000 g
MULTIPLIER RANGE	-	All OUT
CAL LEVEL	-	CCW

3.4 Make sure primary control signal is connected to Channel 1. From desired test specifications put METER RANGE switch and COMPARATOR RANGE Switch on proper full-scale setting. For example, if the primary control level were 8 g, set full scale value at 10 g.

3.5 Set METER SELECTOR switch to Channel 1 and MULTIPLIER switch on Channel 1 to unity. Channel 1 light should be on, and COMPARATOR INPUT meter should be in the appropriate REF. position. If not, a fault in the instrument is indicated.

3.6 Turn CAL. LEVEL control CW until desired control level is indicated on the ACCEL meter. In the example above, an 8 g indication is required.

3.7 Adjust COMPARATOR CALIBRATION for Channel 1 until COMPARATOR INPUT meter indication is on CAL. Turn MULTIPLIER switch to OUT for Channel 1.

3.8 Switch multiplier switch on Channel 2 to unity. Switch meter selector to Channel 2. Leave the CAL. LEVEL control untouched, at the same level that was indicated in paragraph 3.6 above. In the above example, the meter will still read 8 g.

3.9 Adjust the COMPARATOR CALIBRATION for Channel 2 until COMPARATOR INPUT meter indication is on CAL. Turn multiple switch to OUT for Channel 2.

3.10 Repeat procedure 3.9 for all remaining channels that will be used.

3.11 The instrument is now programmed for control by the largest signal for all accelerometers. The control is always at the same g level, 8 g in the example. To operate, switch the MODE switch to OPER. and put all channels on unity on the VARIABLE MULTIPLIER range switch.

If, however, it is desired to put a weighting factor into any of the Channels 2, 3, etc., so that they will take control at some unequal g level (other than 8 g in the example) additional steps are necessary as follows:

3.12 With the MODE switch still on CAL, put the range switch for all channels except Channel 2 on OUT. From the desired test specification select the appropriate range of the VARIABLE MULTIPLIER for Channel 2. In the example used above, where Channel 1 is controlling at 8g, let us suppose that Channel 2 is to take over control if its level rises to 10 g. In this case, the appropriate range is 1-10 because the 8 g is multiplied by 1.25 to obtain 10 g.

3.13 Both Range Switches should be on 10 g. In the following steps <u>do not</u> disturb the setting of the COMPARATOR CALIBRATION which was done in par. 3.9 above. Put the meter selector switch on Channel 2. Now adjust the CAL. LEVEL control until the meter reads 10 g, the level desired for Channel 2. Finally, turn the VARIABLE MULTIPLIER potentiometer (ten turn pot) for Channel 2 until the COMPARATOR INPUT meter is on CAL. In this example, the setting of the pot will be approximately 1.25, that is, the window will be at 1 and the dial will be at 25. This completes the setup for Channel 2.

3.14 As a further example, let us set Channel 3 to control if the level at accelerometer 3 rises to 16 g. Switch all channels to OUT except channel 3, which is switched to VAR. 1-10. Again, <u>do not</u> disturb the setting of Channel 3 COMPARATOR CALIBRATION. Next switch the METER range up

3.14 (continued)

to 30 g. Switch the meter selector switch to Channel 3. Adjust the CAL. LEVEL until the meter reads 16 g. Now adjust the VARIABLE MULTIPLIER ten turn pot until the COMPARATOR INPUT meter is on CAL. The pot window should be at 2 and the dial at approximately zero.

3.15 As a final example, let us set Channel 4 to control at 2 g. Note that this lower level is not normally used except where a channel is used to control cross axis motion.

Put all channels on OUT except Channel 4, which is switched to VAR. .01-1. The meter range is switched to 3 g. Adjust the CAL. LEVEL until the meter reads 2 g. With the meter selector on Channel 4, adjust the ten turn pot until the meter is on CAL. The pot should be indicating .25 (2 g is .25 of 8 g), with the window on 2 and the dial on 50.

3.16 Return MULTIPLIER switch settings for Channels 1 through 6 to the proper ranges for the multiplier values required. All channels which are not being used should be put to the OUT position.

3.17 Put servo in PRESET mode. Return ACS-6 to appropriate OPER. mode. This is necessary to remove standby condition from servo. Set up control value on servo to be the same as that used in 3.4 through 3.6. Turn up OUTPUT control on servo and switch servo through STANDBY to OPERATE. The output level should come up and be controlled by one of the active channels. Start the sweep to begin the test.

3.18 As the frequency of the sine signal is swept throughout the operating range, note that the ACCEL level indicated by the meter on the servo is always the primary control value used in 3.4 to 3.6 regardless of which channel is in control and regardless of the multiplier factor.

The vibration meter on the servo always reads the correct acceleration for channel 1, and reads the correct acceleration for the remainder of the channels (when gated to the ACS-6 output) only when the MULTIPLIER is unity.

3.18 (continued)

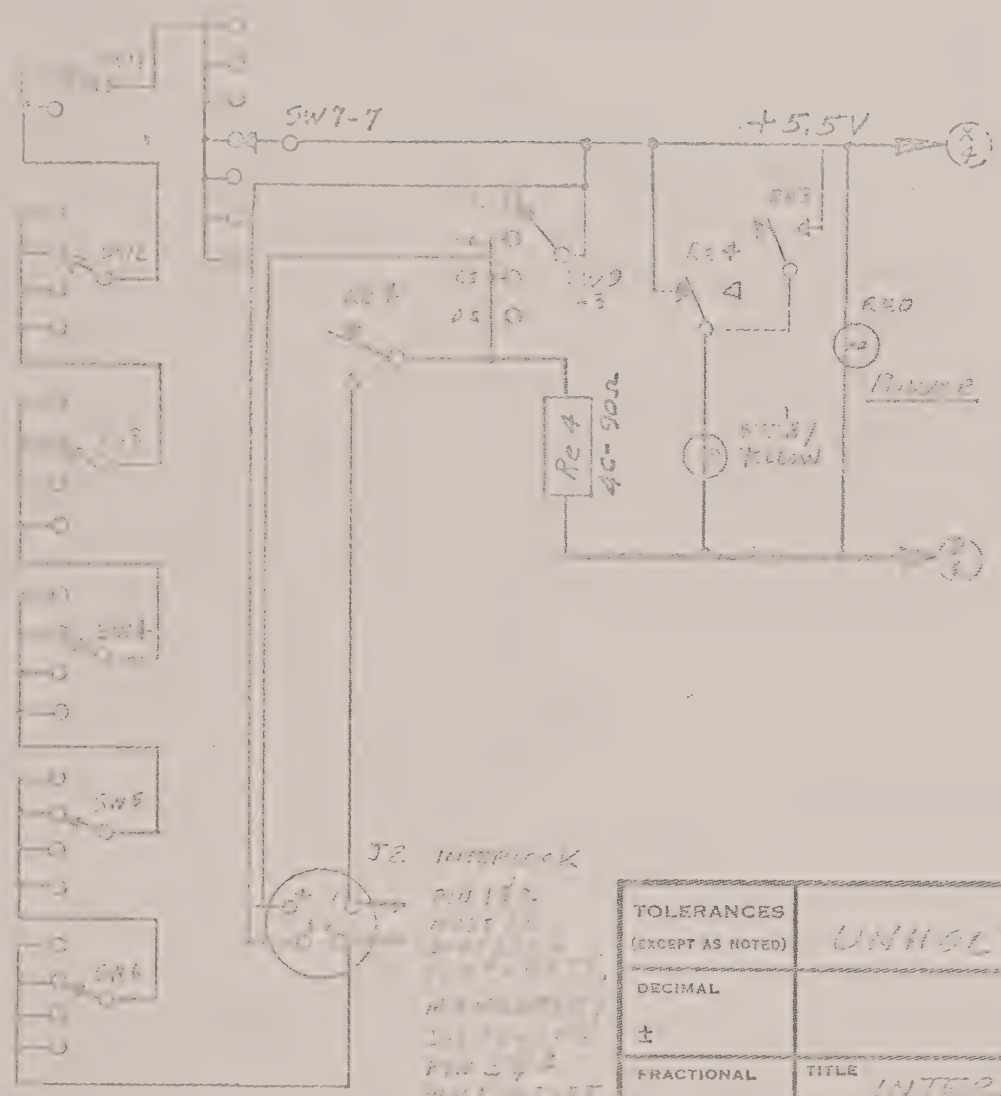
For all other MULTIPLIER values the actual acceleration is related to the indicated value on the servo by

actual value (g) = MULTIPLIER x indicated value

3.19 CAUTION

Channel 1 must always have a proper acceleration input for any test.

ALL BREAK-BEFORE-MAKE CONTACTS



REVISION RECORD				

TOLERANCES (EXCEPT AS NOTED)	UNIVOLTZ - DICKIE CORP		
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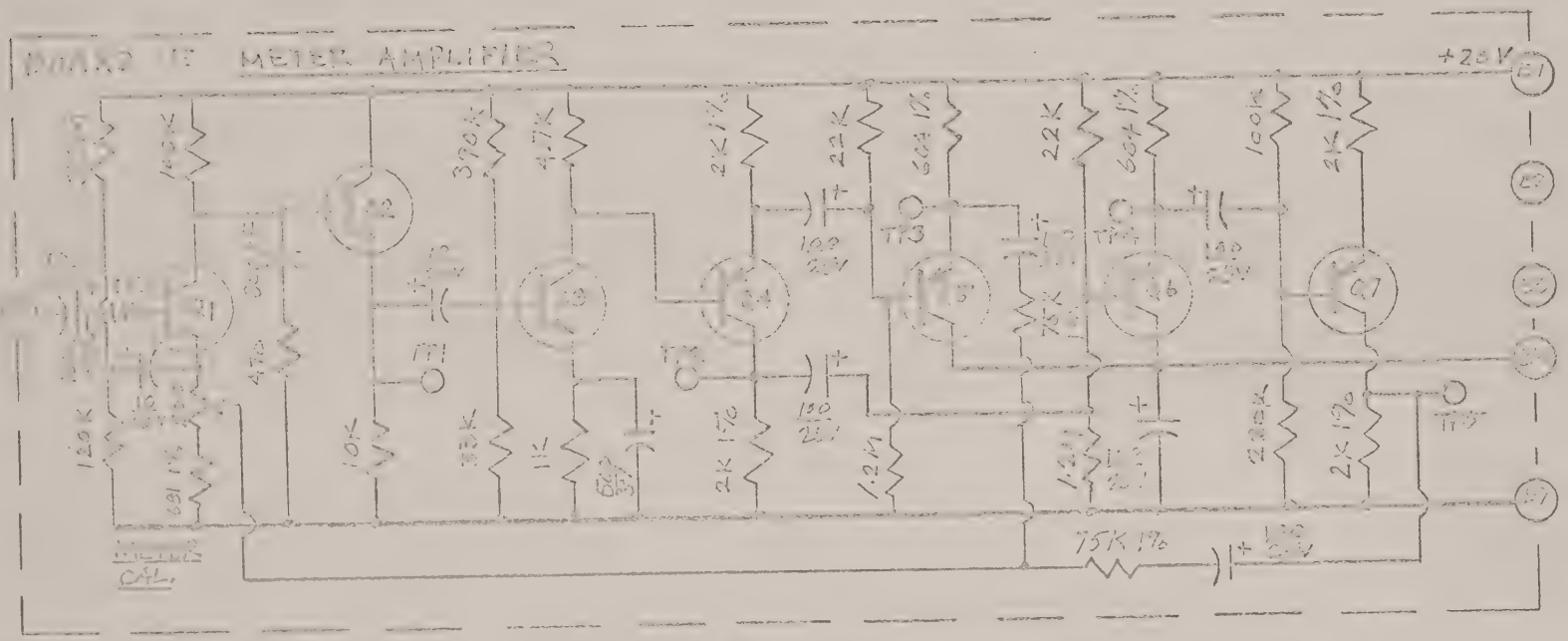
			APPROVED BY
FRACTIONAL ±	TITLE INTERLOCK CIRCUIT MODEL AC1-5		
ANGULAR ±	DATE 9-3-68	DRAWING NUMBER A7863	

ALBANENE © 10 5455 ENGINEERS' STANDARD FORM

MADE IN U.S.A.

DATE	BY	REVISION RECORD	AUTH.	DR.	CK.



Q1, Q2, Q3 2N2484
Q4, Q5, Q6, Q7 2N4058

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
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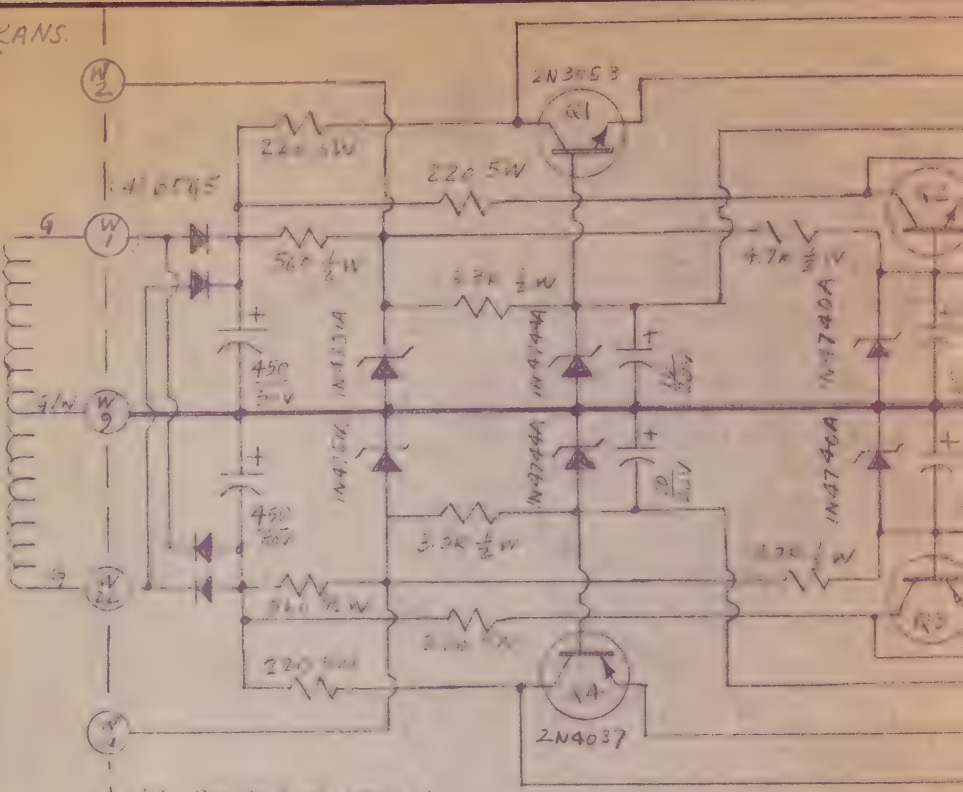
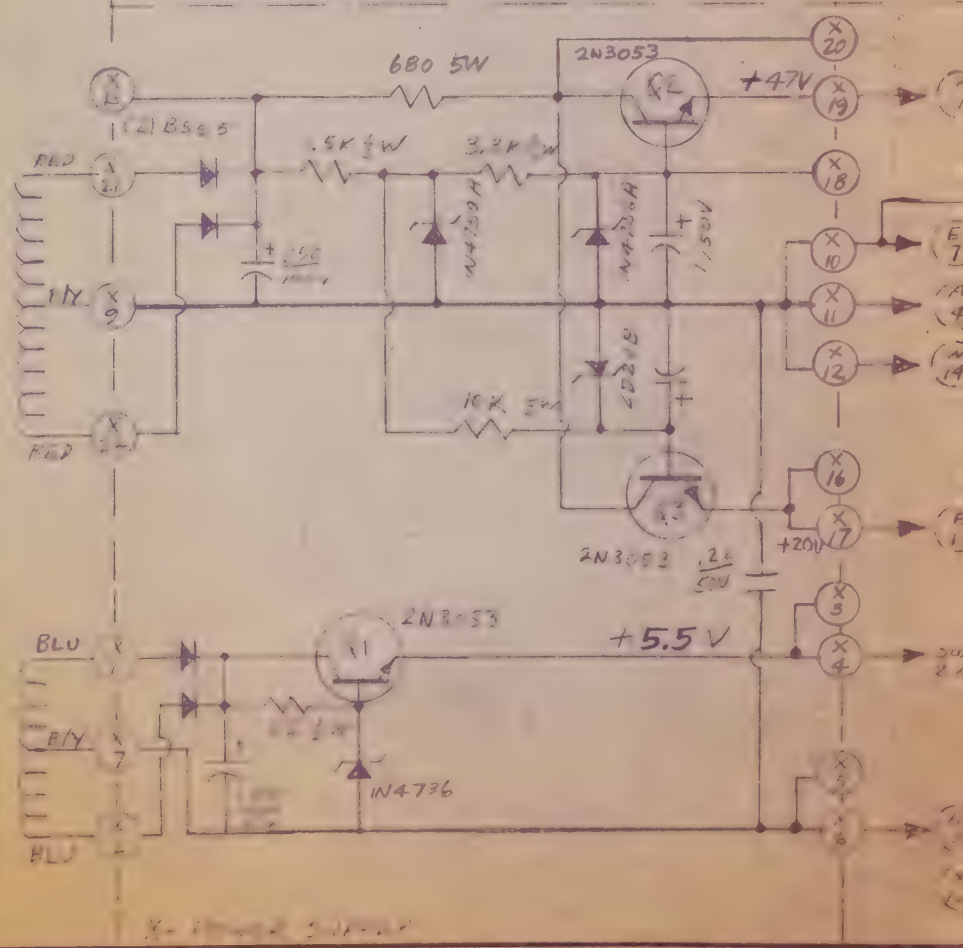
			APPROVED BY
FRACTIONAL ±	TITLE METER AMP BOARD E MODEL ACS-6		
ANGULAR ±	DATE	DRAWING NUMBER A7864	

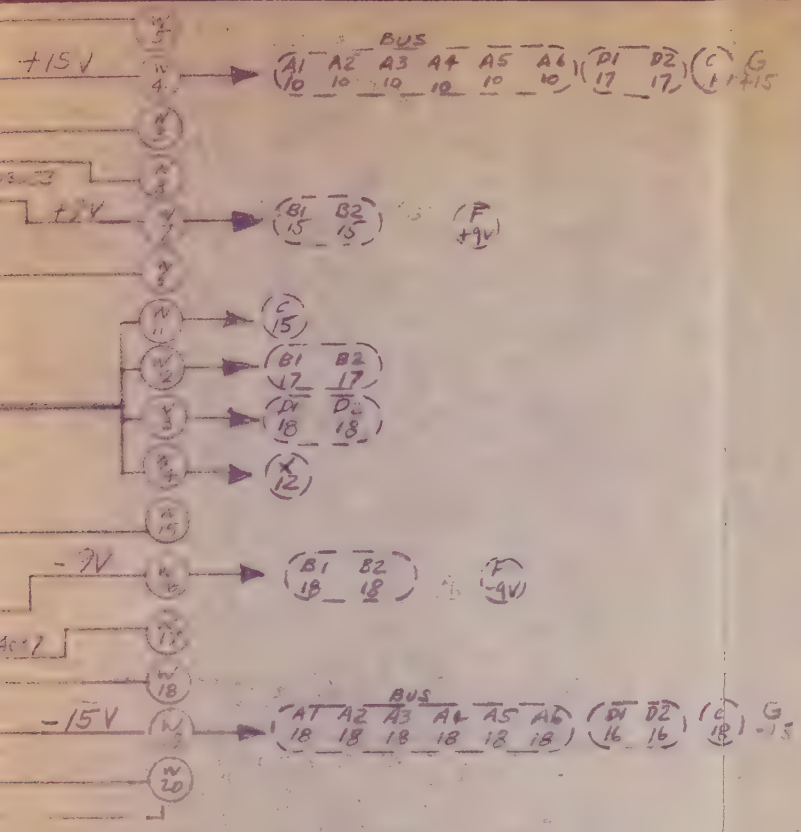
ALDANENE ® 10-5405 ENGINEERS' STANDARD FORM
MADE IN U.S.A. 23353

CENTRAL TRANS.
U15-105

	JUMPERS
115V	1-2 ; 3-4
230V	2-3







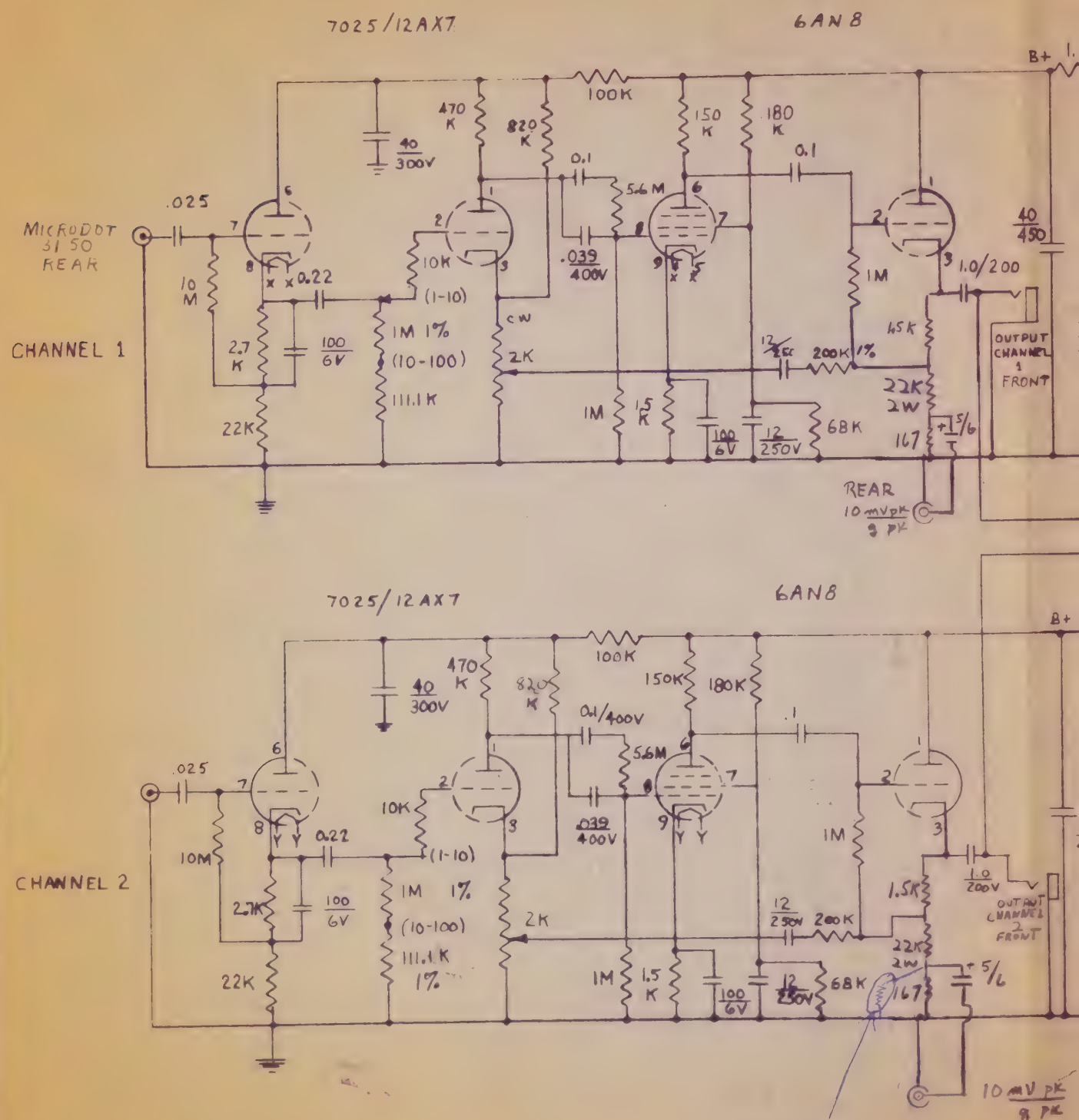
DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
11/15/65	A				

VOLTAGES

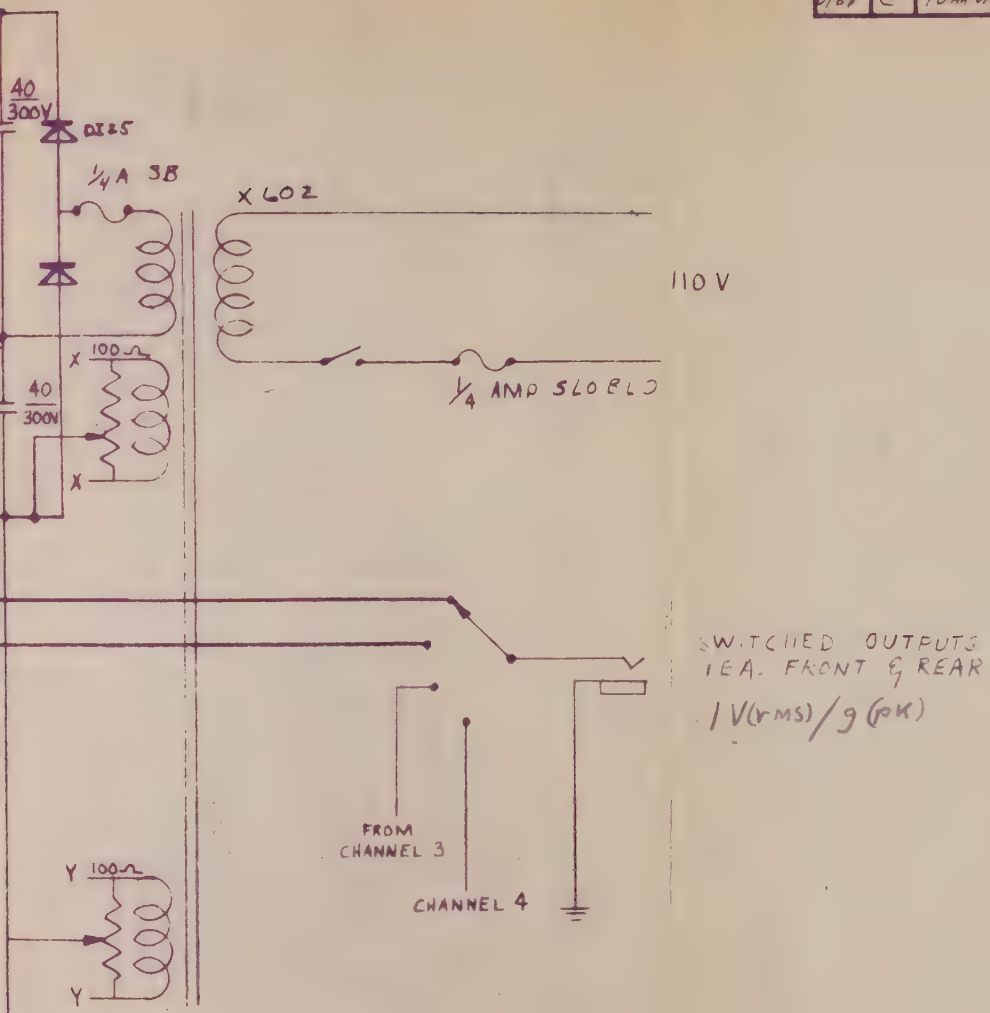
TERM.	X	W
1 A	7 (AC)	31 (AC)
2 B	7 (AC)	30
3 C	+5.5	15 B
4 D	+5.5	15 E
5 E	-.3	39>25>15
6 F	-.3	9 B
7 H	-.3	9 E
8 J		39>25>9
9 K	PWR. GND	Fwr GND
10 L	GND.	
11 M	GND.	GND.
12 N	GND.	GND.
13 P	85	GND
14 R		GND.
15 S		-9 F
16 T	20	-9 E
17 U	20	-39<22<-9
18 V	47 B	-15
19 W	47 E	-15
20 X	>47 C	-39<25<-15
21 Y	65 (AC)	-30
22 Z	65 (AC)	31 (AC)

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±		SCALE	DRAWN BY TU
			APPROVED BY
FRACTIONAL ±	TITLE POWER SUPPLY SCHEMATIC MODEL ACS-6		
ANGULAR ±	DATE 7-8-68	DRAWING NUMBER R7859	

MADE IN U.S.A.
37127


7025/12AX7
6AN8
B+
MICRODOT 3150 REAR
CHANNEL 1
.025
10 M
2.7 K
100 6V
0.22
22K
10K (1-10)
1M 1% (10-100)
111.1K
470 K
820 K
40 300V
100K
150 K
180 K
0.1
5.6 M
.039 400V
2K
1M
15 K
100 6V
12 250V
68K
200K 1%
45K
22K 2W
167
5/6
1.0/200
40/450
OUTPUT CHANNEL 1 FRONT
REAR 10 mV PK 9 PK
7025/12AX7
6AN8
B+
CHANNEL 2
.025
10M
2.7K
100 6V
0.22
22K
10K (1-10)
1M 1%
(10-100)
111.1K 1%
2K
470 K
820 K
40 300V
100K
150K
180K
.01/400V
5.6M
.039 400V
1M
1.5K
1.5 K
100 6V
12 250V
200K
68K
22K 2W
167
5/6
1.0 200V
OUTPUT CHANNEL 2 FRONT
10 mV PK 9 PK
EXTRA SHUNT

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
4-12	A	REMOED 10MMF FROM			
		FEED BACK LOOP			
2/61	B	Added jumper to each	CF		
		Channel			
5/69	C	.01 MV/g to BNC		JD	



NOTE: CHANNELS 3 & 4 SAME AS 1 & 2

EAR

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ - DICKIE CORP		
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			APPROVED BY G.K.
FRACTIONAL ±	TITLE SCHEMATIC MOD. 603 DIAL-A-GAIN		
ANGULAR ±	DATE 2-23-67	DRAWING NUMBER 9104105	

From the manufacturer of complete vibration test systems

UNHOLTZ-DICKIE

Instrument Bulletin

Offering a complete line of
signal conditioning instruments
and accelerometers for vibration

ORIGINATORS OF THE CALIBRATED SENSITIVITY DIAL ■
AUTORANGING ■ RANGE RESTORING ■ AUTOMATIC CALIBRATION
PLOTTING SYSTEMS ■ HIGH POWER TRANSISTOR AMPLIFIERS

SHOCK AND VIBRATION MONITORING INSTRUMENTS

Unholtz-Dickie instruments can be categorized as two general types

COMPACT SIGNAL CONDITIONING MODULES FOR MULTI-CHANNEL DATA ACQUISITION SYSTEMS

These units are generally charge type amplifiers with switchable voltage modes of operation. Their modular construction permits the building block approach and the combination of various features. They have full scale range switching, a direct reading sensitivity dial, variable gain tape output, and optional galvo output, 10mV/g servo output, and meter. Built-in CAL and TEST functions are standard. Other features include AUTO-RANGING, LOG COMPRESSION, extended low frequency response, and compatibility with grounded accelerometers. Wide dynamic range and frequency response are particularly suitable for shock measurements.

DIAL-A-GAIN INSTRUMENTS FOR VIBRATION EXCITER SYSTEMS AND GENERAL LABORATORY USE

These units are generally voltage type amplifiers with normalized 1 V rms/g pk and 10 mV pk/g pk outputs. They are general purpose portable or rack mounted instruments. All have the DIAL-A-GAIN feature — a calibrated sensitivity dial for direct dialing of the transducer sensitivity. Some models read out velocity and displacement in addition to the standard acceleration output. Tape and galvo recording of both acceleration and displacement are available. High accuracy, precision, standardizer DIAL-A-GAIN instruments are used in accelerometer calibration systems and combine switchable charge and voltage inputs with the double integration feature.

GENERALIZED INPUT CHARACTERISTICS

TYPE INPUT	INPUT CABLES GENERALLY USED	TYPICAL NOISE LEVELS (referred to input)	GAIN RANGE	COMMENTS
High Input Impedance, Straight Voltage: DAG Series, 608 Series (Voltage mode)	50 ft or less of subminiature, low noise cable.	DAG Series: <100 μV rms 608 Series: <35 μV rms	DAG Series: 10 to 1000 608 Series: 0 to 10,000	Compatible with wide variety of transducers. Calibration depends on input cable length.
Charge Converter: Model 11 Series, 608 Series	Up to 300 ft of coaxial cable. Connection to accelerometer is subminiature, low noise cable with optional conversion to RG/U coaxial cable runs.	Model 11 Series: .003 pC rms + .002 pC rms/1000 pF 608 Series: .03 pC rms + .01 pC rms/1000 pF	Model 11 Series: 0 to 5,000 mV/pC 608 Series: 0 to 10,000 mV/pC	Calibration is independent of cable lengths normally used. Model 11 series achieves ultra low noise levels for short input cables. Low noise cable required when cable whip is expected.
Remote Impedance Converter: Model 11PA-2 with Model 11 Series (Voltage Mode)	Short length of subminiature, low noise cable connected to accelerometer, and up to 2000 ft of RG/U coaxial cable to rack mounted instrument.	<35 μV rms	unity	Low output impedance drives long cables and uses standard RG/U coaxial types. Compatible with wide variety of transducers. Calibration depends on input cable length.
High Input Impedance, Driven Shield Voltage: 610 Series	25 to 100 ft of special triaxial cable with short length of subminiature low noise cable connected to the accelerometer.	<100 μV rms	0 to 7,000	Reduces capacitance loading effects on accelerometer. Calibration depends on input cable length.

		MODEL	19" Wide Rack Mount	Channels in 19" Width	Portable	Voltage Input (High Impedance)	Charge Input	Voltage Input with Remote Model 11PA-2	1V rms/g peak Normalized Output	10 mV/g Normalized Output	96.4 mV/in/sec Velocity and 1V rms/in DA Disp. Outputs	Adjustable Full Scale Tape Output	Adjustable Full Scale Galvo Output	
DIAL-A-GAIN SERIES		601		1	✓	✓			✓	✓				pg. 6
		601R-A	✓	1		✓			✓	✓				pg. 6
		602		2	✓	✓			✓	optional				pg. 6
		602R	✓	2		✓			✓	✓				pg. 6
		603R	✓	4		✓			✓	✓				pg. 6
		606M		1	✓	✓			✓	optional				pg. 6
		606RM	✓	1		✓			✓	optional				pg. 6
		610RM	✓	1		✓			✓	optional	✓			pg. 6
		610RMG-3	✓	3		driven shield			✓	✓	✓	0-5 V pk	0-10 V pk	pg. 6
		V608R-12A	✓	1		✓			✓	✓	✓			pg. 6
		CV608R-12A	✓	1		✓	✓		✓	✓	✓			pg. 6
608 SERIES		8PMCVA	with 608R	1-6	with 608PS-1	✓	✓			✓		0-2.5Vpk	0-10 V pk	pg. 5
		8PMCV	with 608R	1-6	with 608PS-1	✓	✓			✓		0-2.5Vpk	0-10 V pk	pg. 5
		8PCV	with 608R	1-6	with 608PS-1	✓	✓			✓		0-2.5Vpk	0-10 V pk	pg. 5
		8PMXCV	with 608R	1-6	with 608PS-1	✓	✓			✓		0-2.5Vpk	0-10 V pk	pg. 5
		8PXCV	with 608R	1-6	with 608PS-1	✓	✓			✓		0-2.5Vpk	0-10 V pk	pg. 5
MODEL 11 SERIES	BASIC	D11V	with 11R	1-6	✓		✓	✓		optional		0-5 V pk		pg. 4
		D11MV	with 11R	1-6	✓		✓	✓		optional		0-5 V pk		pg. 4
		D11GV	with 11R	1-6	✓		✓	✓		optional		0-5 V pk	0-5 V pk	pg. 4
		D11MGV	with 11R	1-6	✓		✓	✓		optional		0-5 V pk	0-5 V pk	pg. 4
	AUTORANGER	11MAV	with 11R	1-6	✓		✓	✓		optional		0-5 V pk		pg. 4
		11GAV	with 11R	1-6	✓		✓	✓		optional		0-5 V pk	0-5 V pk	pg. 4
		11MGAV	with 11R	1-6	✓		✓	✓		optional		0-5 V pk	0-5 V pk	pg. 4
	LOG AMP	11MSLV	with 11R	1-6	✓		✓	✓		optional		0-5 V pk		pg. 4
		11GSLV	with 11R	1-6	✓		✓	✓		optional		0-5 V pk	0-5 V pk	pg. 4
		11MGSLV	with 11R	1-6	✓		✓	✓		optional		0-5 V pk	0-5 V pk	pg. 4
	w/11PA-2	V11MS	with 11R	1-6	✓			✓		✓		0-5 V pk		pg. 5
		V11GS	with 11R	1-6	✓			✓		✓		0-5 V pk	0-5 V pk	pg. 5
		V11MGS	with 11R	1-6	✓			✓		✓		0-5 V pk	0-5 V pk	pg. 5

CHARGE/VOLTAGE AMPLIFIERS FO

conditions signals from piezoelectric tra

MODEL 11 SERIES CHARGE AND VOLTAGE WITH INDIVIDUAL POWER SUPPLIES

This new series of signal conditioning amplifiers features individual double shielded power supplies, vinyl-clad, totally enclosed case, solid state printed circuitry, ultra low noise levels, portability of separate units, wider frequency range, and switchable charge or voltage operation. Panel height only 5¼ inches with meters. Full scale ranges of .1 g to 10K g with accelerometer sensitivities from 1 pC/g to 100 pC/g.

D11 SERIES

Model D11V	Model D11MV	Model D11GV	Model D11MGV
Tape output only	Tape and meter	Tape and galvo	Tape, galvo, meter
$525.00	$575.00	$590.00	$640.00

Basic D11 series permits operation with grounded accelerometers while eliminating usual ground loop problems. Differential circuitry provides rejection of common mode signals by a factor of 1000 or more.

OPTIONAL FEATURES

S	10mV/g Servo Output	$50.00
O	1 kHz Internal Calibration Oscillator — fixed amplitude, sine wave	$50.00
F	Floating DC output for amplifiers supplied with meters	$25.00
—8	Large Meter (2½ inch scale) with 8¾ panel height	$20.00
LFI	Extended low frequency response (±5% down to 0.2 Hz)	$50.00

AUTORANGER SERIES

Model 811M	Model 11 MAV	Model 11 GAV	Model 11 MGAV
Range restorer	Tape and meter	Tape and galvo	Tape, galvo, meter
$1200.00	$745.00	$760.00	$810.00

AUTORANGER series selects best of 3 adjacent full scale ranges. Pilot light and dc code signals indicate range selected. Range sequences of 1, 3, 10 . . ., or 1, $\sqrt{10}$, 10 . . . or 1, 10, 100 . . . are offered. Companion RANGE-RESTORER converts tape recorded data to original dynamic range.

OPTIONAL FEATURES

S	10mV/g Servo Output	$50.00
O	1 kHz Internal Calibration Oscillator — fixed amplitude, sine wave	$50.00
F	Floating DC output for amplifiers supplied with meters	$25.00
—8	Large Meter (2½ inch scale) with 8¾ panel height	$20.00

LOG AMP SERIES

Model DADC-5	Model 11 MSLV	Model 11 GSLV	Model 11MGSLV
Differential AC-DC converter	Tape and meter	Tape and galvo	Tape, galvo, meter
$1400.00	$800.00	$815.00	$865.00

Log amp series compresses 1000:1 input signal variation to 4:1 output signal variation. Waveform and frequency content of output is same as input. When combined with companion DADC-5, direct measurement of transmissibility can be made down to 5 Hz.

OPTIONAL FEATURES

T	Matched performance and use with Tracking Filter	$200.00
O	1 kHz Internal Calibration Oscillator — fixed amplitude, sine wave	$50.00
F	Floating DC output for amplifiers supplied with meters	$25.00
—8	Large Meter (2½ inch scale) with 8¾ panel height	$20.00

MODEL 11P-2
Dual Channel Portable Adapter
with 2 channels of Model 11 series
Model 11P-2 **$70.00**

MODEL 11 SERIES
With -8 option

MODEL 11R~~A~~
Rack Frame Adapter
with 6 channels of Model 11MGA
Model 11R~~A~~ ~~$200.00~~ $125.00
Blank Panel $7.50

11RA-8 — $175.00

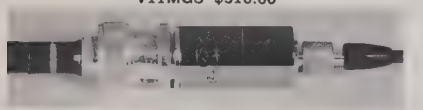
cers for driving tape and galvo recorders

ECONOMY MODEL V11 AMPLIFIERS FOR USE WITH REMOTE CHARGE OR VOLTAGE PREAMPLIFIER

The Model V11 amplifier is a lower cost instrument that deletes the charge input stage of the standard Model 11 series and uses a remote preamplifier for conversion of the transducer output to a low impedance signal. The remote preamplifier can be selected as either the Model 11CA-2 charge input type or the Model 11PA-2 voltage input type. The Model V11 amplifier has screw driver adjustment for the tape and galvo outputs, a 2 position calibrate switch, Option I full scale ranging, and deletes the switchable filter feature. **V11MS $445.00**

V11GS $465.00

V11MGS $510.00



MODEL 11CA-2 REMOTE CHARGE PREAMP

When connected to any Series 11 amplifier, this low noise remote charge preamplifier eliminates cable noise and provides a 1 mV/pC conversion gain. The less than 50 ohm output impedance drives up to 2000 feet of standard RG/U coaxial cable. The unit is packaged as a BNC to Microdot type adapter. **$80.00**

MODEL 11PA-2 REMOTE VOLTAGE PREAMP

When connected to any Series 11 amplifier, this remote voltage preamplifier provides 1000 megohm input impedance, less than 50 ohm output impedance, and unity gain. This preamplifier is particularly suitable for use with "voltage" type piezoelectric transducers and is compatible with both resistive and capacitive type transducers. The low output impedance eliminates cable noise problems and will drive up to 2,000 feet of standard RG/U coaxial cable. The unit is packaged as a BNC to Microdot type adapter. **$50.00**

MECHANICAL IMPEDANCE & TRANSMISSIBILITY ACCESSORIES

These basic building block components permit automatic plotting of mechanical impedance, transmissibility, or the ratio of two complex quantities. The frequency range of 5 Hz to 20 KHz is covered with a dynamic range capability of up to 120dB. Each instrument contains its own power supply and can be used as a separate, portable unit when not mounted in the Model 11R Rack Frame Adapter.

MODEL 11MGSL	MODEL 11MGSL	MODEL DADC-5	MODEL LFC-5	MODEL MAC-2	MODEL MC-10

Model 11MGSL
Any of the log type charge amplifiers, with the options described on page 4, eliminate the need for 2 separate log converters and fulfill a wide range of signal conditioning requirements.

Model DADC-5
Differential AC-DC Converter. DC output represents ratio of the two measured quantities. $1,400.00

Model LFC-5
Log Frequency Converter. DC output represents logarithm of input frequency. $750.00

Model MAC-2
Averaging Control. Permits control to weighted average of measured quantities. $650.00

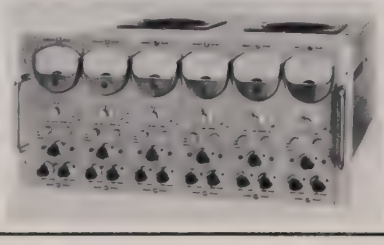
Model MC-10
Mass Compensator. Compensates for component of measured force used to drive head of force transducer. $495.00

608 SERIES CHARGE AND VOLTAGE WITH COMMON POWER SUPPLY

8PMCVA Auto-Ranger	8PMCV	8PCV	8PMXCV	8PXCV
Automatic Ranging				
Meter	Meter		Meter	
Galvo output	Galvo output	Galvo output		
Tape and servo output	Tape and servo output	Tape and servo output	Tape and servo output	Tape and servo output
$655.00	$485.00	$425.00	$415.00	$355.00

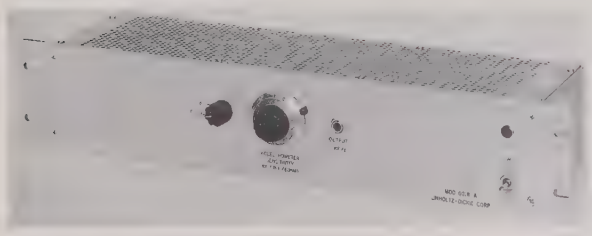
608PS-1 PORTABLE POWER SUPPLY WITH PLUG-IN MODULES Accepts up to two modules in any combination
608PS-1 $410.00

608R POWER SUPPLY AND RACK FRAME ADAPTER WITH PLUG-IN MODULES Accepts up to 6 modules in any combination
608R $540.00



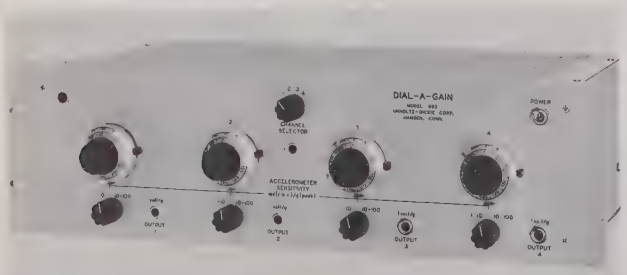
DIAL-A-GAIN SERIES VOLTAGE AMPLIFIERS

MODEL 601 **$225.00**
General purpose portable instrument for measurement of acceleration. Convenient 1 V rms/g pk and 10 mV/g outputs for readout on oscilloscope or voltmeter. .01 g to 100 g without range switching. Direct dialing of any accelerometer sensitivity from 1 to 100 mV rms/g pk

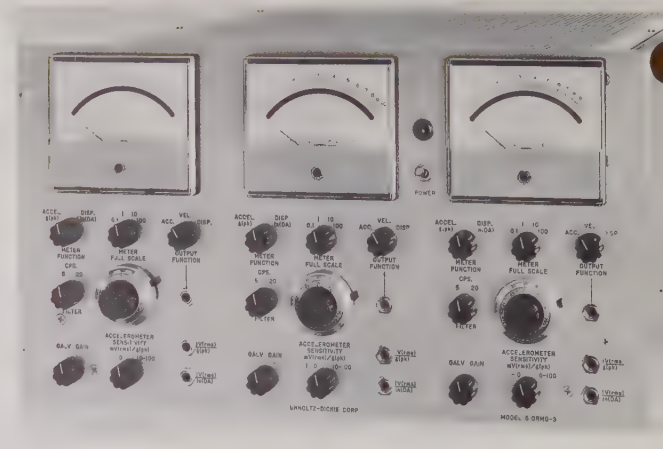


MODEL 601R-A **$260.00**
Rack mounted version particularly suited for exciter system servo control. Operation with the Model 20D21 accelerometer provides excellent low level displacement control down to 5 Hz.

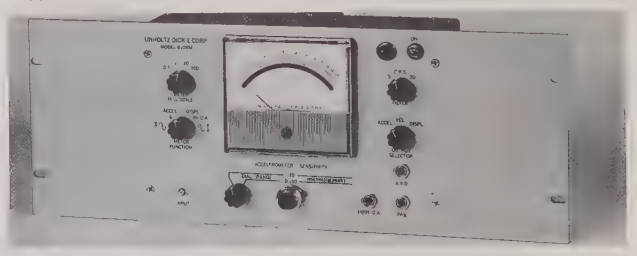
MODEL 602 **$375.00**
MODEL 602R (rack mount) **$410.00**
2 channel version. Front panel switch selects either channel for easy monitoring or comparison on external voltmeter



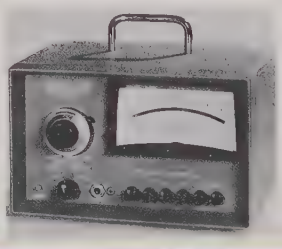
MODEL 603R **$695.00**
Low cost 4-channel instrument



MODEL 610RMG-3 **$2,150.00**
This versatile vibration monitoring instrument combines double integrating features with high current outputs for driving high frequency galvanometers. Acceleration outputs normalized at 1 V rms/g pk and 10 mV/g in addition to full scale ranging at 1, 10, 100 g. Velocity output at 96.3 mV/in/sec. Displacement output normalized at 1 V/in DA and full scale ranged at .1, 1, 10 in. DA. Galvo output adjustable from 0 to 10 V pk full scale level. Large, accurate logarithmic meters indicate acceleration or displacement. Driven shield input with 25' triaxial cable supplied for each of the three channels.



MODEL 610RM **$730.00**
Single channel, rack mounted, double integrating, no galvo output



MODEL 606M **$395.00**
MODEL 606RM (rack mount) **$430.00**
Same as Model 601 with integral meter and full scale ranges of 1, 3, 10, 30 and 100 g

MODEL V608R-12A **$975.00**

Reference accelerometer is connected to one V or CV standardizer and unknown accelerometer is connected to a second V or CV standardizer. When outputs are adjusted equal, the sensitivity of the unknown accelerometer is read directly on the precision sensitivity dial of the unknown channel. This procedure is applicable to accelerometers, velocity

MODEL CV608R-12A **$1,500.00**

pickups, or other transducers, since these double integrating instruments have acceleration, velocity, and displacement outputs. Acceleration frequency response is within ±0.5% from 10 Hz to 10 KHz (since both channels are matched this error virtually disappears). Velocity response is ±1%, 10 Hz to 2 KHz. Displacement response is ±1.5%, 10 Hz to 70 Hz.

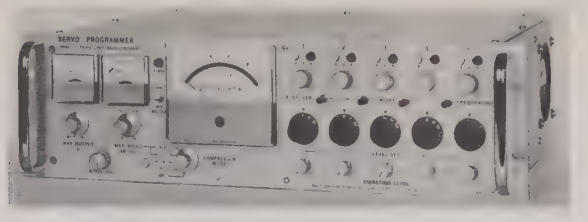
ACCESSORY INSTRUMENTS
for control and protective functions

MODEL AFP SERIES
ARBITRARY FUNCTION PROGRAMMER

- Curve follower programs arbitrary function of acceleration vs. frequency
- 50 dB amplitude range
- 3 decade frequency range
- Controls average or largest of several accelerations to program
- Use with MAC-6C or ATC-6

Model AFP-1 **$3,475.00**
(Use with SP-1M, SP-2 and SP-5 servo and MAC-6C)

Model AFP-6 **$4,950.00**
(Use with ATC-6 and BK 1025)

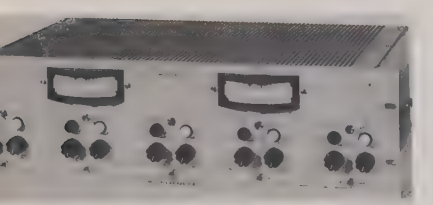


SERVO PROGRAMMERS

Features: Combines functions of amplitude servo and vibration programmer in one instrument ■ Programmer contains up to five program segments with servo controlled acceleration, velocity, or displacement selectable for each segment (SP5) ■ Simplified closed-loop presetting of vibration levels before actual test is performed ■ Solid state, plug-in, printed circuit construction ■ Analog output for recording levels.

$2995.00

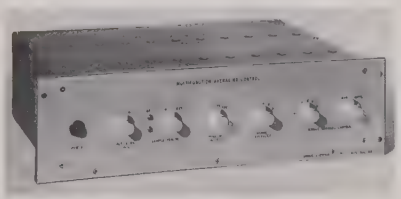
MODEL SP-5 (5 segment programmer) ~~$4,130.00~~
MODEL SP-2 (2 segment programmer) $2,330.00
~~**MODEL SP-1M** (servo only, vibration meter) $1,750.00~~



MODEL AP-5
AUTOMATIC PROGRAMMER
FOR BK SERVOS

- Up to five programmed vibration levels
- Any combination of displacement and acceleration in sequence
- Any combination of velocity and acceleration in sequence
- Amplitude settings with 100 to 1 range
- Direct vibration reading on BK 1039 or BK 1025 at all times
- Complete independence of amplitude and transfer frequency controls
- Pilot lights indicate mode of operation at all times
- Programmed control can be switched out for normal operation
- Size 19" wide x 5¼" high

Model AP-5 (including rework of BK) **$2,000.00**



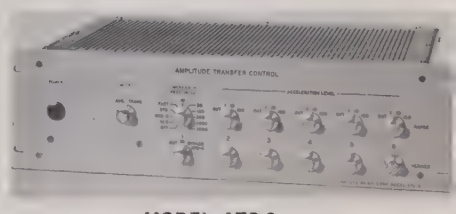
MODEL MAC-6C
MULTIFUNCTION AVERAGING CONTROL

Features: Phase insensitive averaging for at least 6 inputs • Allows averaged shaker system control for sine and random tests • Sine tests: absolute average of output yields average of input magnitudes • Random tests: spectral density of output yields average of input spectral densities • Freedom from detector time constant problems. • 2 or more units can be coupled • Analog DC output

Model MAC-6C **$1,850.00**

Model MAC-2. Two channel unit in model 11 modular case. Increases dynamic range of impedance system by controlling to weighted average of force and acceleration.

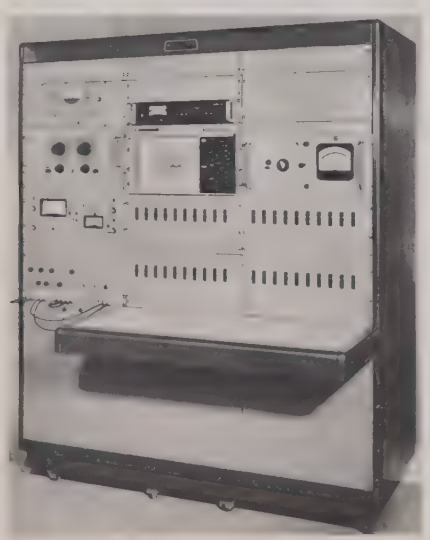
Model MAC-2 **$650.00**



MODEL ATC-6
AMPLITUDE TRANSFER
OR AVERAGE CONTROL

Features: Dual function instrument provides control of sine tests from highest of up to six acceleration inputs or from their average • Transfer mode maintains acceleration of each input at or below individually pre-set levels • Negligible overshoot when control transfers from one channel to another • Average mode provides control from phase-insensitive average of input accelerations • 2 or more units can be coupled • Operates with BK 1039 and BK 1025 only

Model ATC-6 **$2,400.00**



RV500B RANDOM NARROW BAND
EQUALIZER AND RECORDING
ANALYZER

Complete Random Control Center for use with any sine shaker system. Equalizer section includes noise generator, spectrum shaping filter, shaker equalizer, forty channel specimen equalizer, adjustable acceleration level clipper and provisions for mixing sine and random. Analyzer section includes true rms voltmeter, sweeping narrow band analyzer with switchable filters, and log converter and plotter for recording spectral density vs frequency. Analyzer may also be used as random reject filter for conducting servo controlled combined sine-random tests. Patch panel allows use of analyzer as a tracking filter during sine tests.

MODEL E105
SPECTRUM SHAPER

- Simple economical method of converting sine shaker systems for random testing with small specimens
- Fourteen band-pass filters covering the frequency range from 20 cps to 2KC with independent amplitude control allows flattening the shaker-specimen frequency response
- Typical systems with light specimens can be adjusted within ±1½ db of a flat response
- Also includes provisions for shaping the spectrum (other than flat) as required by some specs
- Provisions for mixing sine and random signals

Model E105 (14 channels) **$1,750.00**

ACCELEROMETERS

MODEL		VOLTAGE SENS. mV pk/g pk	CHARGE SENS. pk PCMB/g pk	CAPACITANCE PF	MOUNTED RESONANT FREQ.	SIZE WEIGHT in - grams	DESIGN TYPE	CRYSTAL MATERIAL	PRICE
*2E3 *2E5	Subminiature, extremely small, lightweight for highest frequencies or minimum added mass. 2E5 has wrenching flats for removal.	2.5	1.0	380	70 KHz	.225 Dia. x .225 Ht. .065 grams	Shear Integral Cable Adhesive Mount	PZT.	$213.00
*5D21-8	General purpose. Relatively small with moderately high resonance. Recommended for charge use.	4.0	8.0	2000	40 KHz	.50 Hex. x .64 Ht. 13 grams	Shear Top Connector 10-32 Mtg. hole	PZT.	$185.00
*5D21	Similar to 5D21-8. Recommended for voltage use.	6.5	12.0	2000	40 KHz				
*10D21	Similar to 5D21 with slightly increased sensitivity. Recommended for voltage use.	9	13.0	1400	35 KHz				
*10DQ21	General purpose with side connecting cable for restricted height applications.	20	40	2000	30 KHz	.62 Hex. x .71 Ht. 25 grams	Shear Side Connector 10-32 Mtg. hole	PZT.	$185.00
*5D41	High internal capacitance for direct connection to a scope or VTVM.	7.5	75	10000	30 KHz	.62 Hex. x .71 Ht. 25 grams	Shear Top Connector 10-32 Mtg. hole	PZT.	$213.00
*20D21	General purpose. Recommended for voltage use when 35 foot or longer accelerometer low noise cable is used.	20	30	1500	30 KHz				$185.00
*25D21	Similar to 20D21. Recommended for voltage use when 50 foot or longer accelerometer low noise cable is used.	27	38	1400	30 KHz				
*13D6B	Approximately flat voltage and charge sensitivity vs frequency from 5 Hz to 5 KHz	13	5	375	30 KHz				$200.00
*75D21	Maximum voltage and charge sensitivity gives best signal/noise ratios for very low level vibration measurements.	70	70	1000	20 KHz	.75 Hex. x .70 Ht. 37 grams			$185.00
8B6	Wide temperature range —300° to +500° F. Approximately flat voltage and charge sensitivity vs frequency from 5 Hz to 5 KHz.	3.3	8.0	2400	30 KHz	.76 Dia. x .88 Ht. 36 grams	Compression Double Base Top Connector 10-32 Mtg. hole	Bismuth Strontium Titanate	$220.00
~~8Q10~~	~~Quartz precise calibration standard. Designed to be used as NBS Calibrated Standard. Minimum variation in sensitivity with temperature, approximately flat voltage and charge sensitivity vs frequency.~~	~~9.0~~	~~2.0~~	~~225~~	~~30 KHz~~			~~Quartz~~	~~$310.00~~

*Shear type piezoelectric construction for least base or case strain and cable motion response to external inputs.

Request quantity discount schedule

Some instruments available for 220 volt, 50 cycle, packed for export at 7.5% extra; check with factory.

Specifications and prices subject to change without notice.

manufacturers of shaker systems, advanced instrumentation, and accelerometers

UNHOLTZ-DICKIE CORPORATION

3000 WHITNEY AVE. / HAMDEN, CONN. 06518 / (203) 288-3358

UNHOLTZ-DICKIE CORPORATION

vibration generation systems and measurement instruments

MODEL ACS-6 ACCELERATION CONTROL SELECTOR
AUTOMATICALLY SWITCHES TO THE HIGHEST (OR LOWEST) ACCELERATION INPUT

FEATURES

- Universal instrument operates with any servo
- Accepts 6 acceleration signals and gates to the output whichever acceleration signal reaches its preset limit
- Two modes allow limiting acceleration at 6 points to be less than or alternately greater than preset levels
- Pilot light indicates channel in control
- Solid-state switching
- Switching speed varies continuously with frequency for optimum response
- Switching detection time always faster than servo response time
- Weighting of selection level on channels two through six continuously adjustable from 10 times to 0.01 times channel one acceleration level.
- Calibrated ten turn locking dials set and indicate the weighting factor
- Wide dynamic range: With unity weighting, noise level is less than .03 g. Maximum input 1000 g.
- Large accurate vibration meter switchable to monitor any channel
- DC output (single ended) for recording metered channel
- Panel switch controls affecting vibration level interlocked to put servo in Standby when changed during operation
- Internal calibration signal provides check of instrument operation and presetting of controls prior to shaker operation
- Compatible with MAC-6C Six Channel Averaging Control connected to any input channel
- All solid-state with plug-in PC card construction

GENERAL

The Model ACS-6 Acceleration Control Selector is a device for automatically selecting one acceleration signal from as many as six input acceleration signals for amplitude servo control of sine vibration tests. The all solid-state unit gates the selected signal to its output corresponding to the input of the servo. See block diagram Fig. 1.

Multiple accelerometers mounted at a number of points on a resonant test item experience changes in relative acceleration magnitudes as the operating frequency is changed. If only one accelerometer were used and its acceleration magnitude was maintained at a constant level by the amplitude servo, wide variations in acceleration magnitude would be experienced at the other accelerometer locations. The ACS-6 can be used to switch control to an accelerometer which otherwise would exceed an arbitrary upper limit of acceleration. An example using two accelerometers only is shown in Figure 2. Channel 1 is set to control at 5 g pk, while Channel 2 is set to limit at 10 g pk. Channel 2 could have been set to control at 5 g pk also if preferred, in which case Channel 1 would have been reduced to half the value shown at 370 Hz, the resonant frequency of Channel 2. Up to 6 channels of control could be used simultaneously. Two are illustrated for reasons of simplicity.

Two operating modes are provided. A switch selects the "largest" or the "smallest" operating mode. In the "largest" mode, the ACS-6 switches to the acceleration input channel which rises to its preset value of acceleration, all other channels being below their limiting preset values. In the "smallest" mode, the ACS-6 switches to the acceleration input channel which falls to its preset value of acceleration, all other channels being above their limiting preset values.

The time required for determining that switching should take place as well as the time to actually switch must be held to an absolute minimum to limit overshoot or undershoot of acceleration magnitude at the time of accelerometer switching. Solid-state switching in the ACS-6 avoids the time lag of mechanical relays. The detection speed used to trigger switching is continuously varied as a function of operating frequency to the optimum value. This results in a switching speed equal to or faster than the amplitude servo response time which in turn is limited by added distortion or by the test item resonance causing amplitude instability (hunting).

APPLICATIONS

The ACS-6 Acceleration Control Selector has application for vibration sine testing to avoid over-testing, to limit the maximum value of acceleration on a resonant component, to protect against loss of control accelerometer signal and to limit cross axis acceleration. A test may be conducted with all of these forms of control and protection operating simultaneously.

The foregoing applications would use the "largest" mode of operation on the ACS-6. By switching to the "smallest" mode of operation, under-testing would be avoided in accordance with MIL-STD-810B dated 15 June 1967, paragraph 5.4, page 514-8.

a. Over-test Protection

If due to the size and/or resonances in a test item, it becomes impossible to obtain equal motions at all input attaching points through the test frequency range, over-testing can be avoided by using the ACS-6. One accelerometer is mounted at each input point on the item. Whenever one accelerometer exceeds the acceleration magnitude of all the others, it automatically takes control suppressing the acceleration magnitudes at the other points. In this case, all accelerometers control to the specification acceleration when in control and all channels are set to a multiplier factor of unity. See instrument front panel.

b. Maximum Acceleration Limit

Occasionally a component must be mounted in a larger assembly where at particular operating frequencies the vibration level greatly exceeds the vibration level at the input to the assembly. The designer may wish to limit the acceleration level seen by the component. This can be done by mounting an accelerometer on the component in question, in addition to the accelerometers attached to the vibration input points of the assembly, and connecting it to any channel other than number one of the ACS-6. The limiting value of acceleration, where the accelerometer mounted on the component takes control of the test, can be set to any value from 1 to 10 times the main controlling channel acceleration level. For example, if the test were to be run at 20 g, the component accelerometer channel could be set to limit at any value from 20 to 200 g. (50 g to 500 g if the test were run at 50 g etc).

c. Protection from Loss of Control Accelerometer Signal

By mounting two accelerometers side by side, if one should fail to send its signal to the ACS-6, the ACS-6 would automatically switch to the second for control. Dual accelerometers could be used at more than one mounting location if desired, up to a total of six input accelerometers.

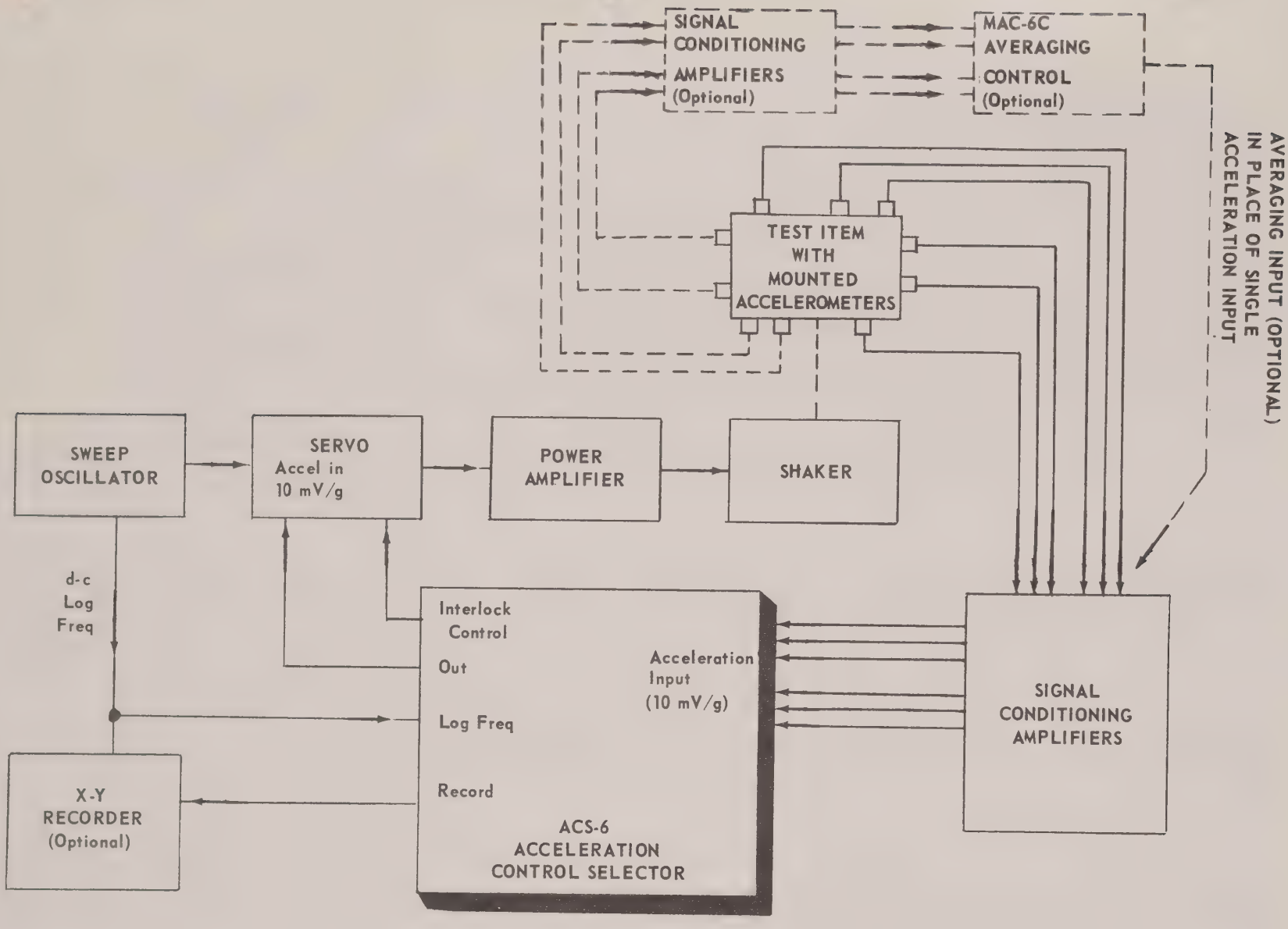


FIG. 1 BLOCK DIAGRAM

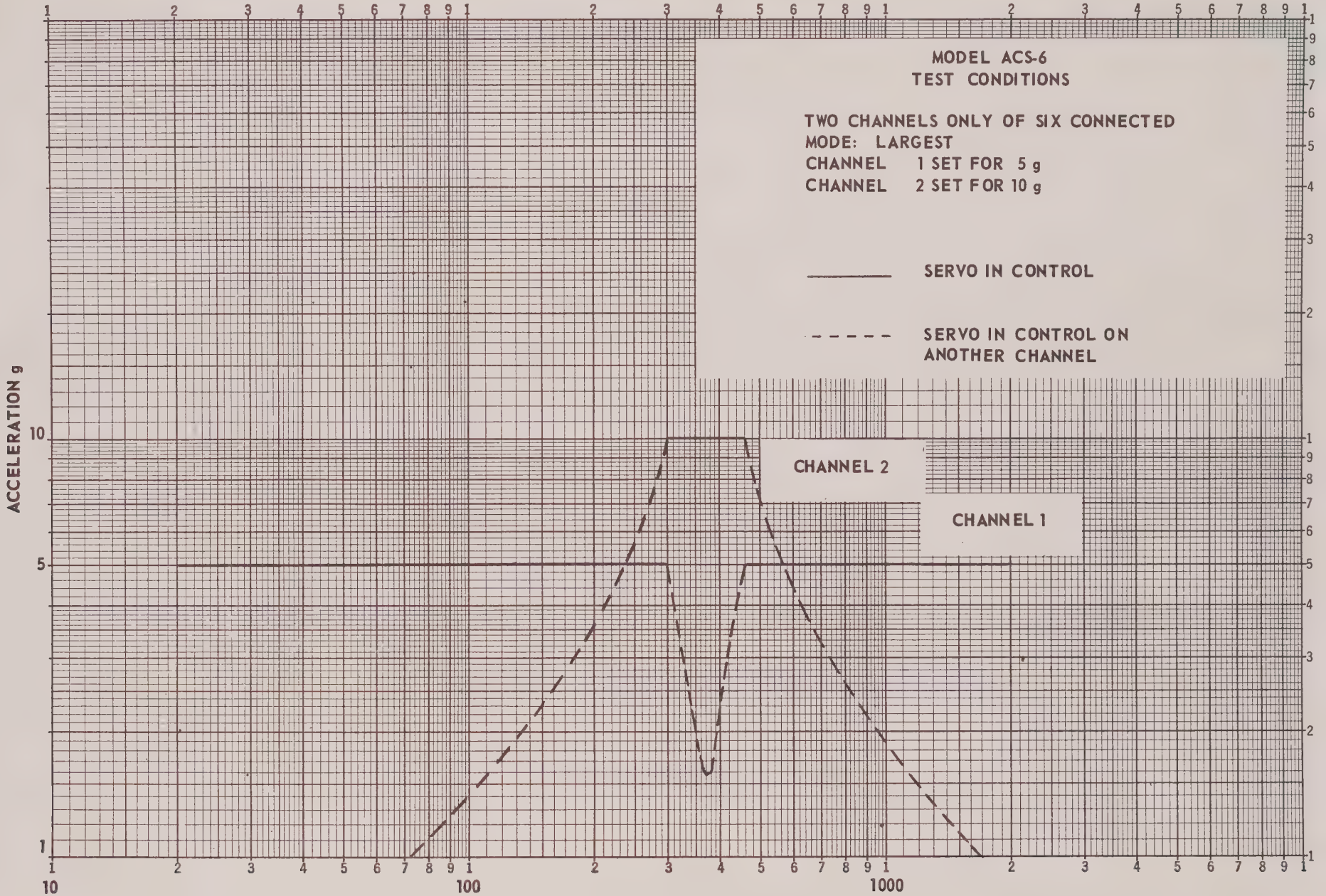

MODEL ACS-6
TEST CONDITIONS
TWO CHANNELS ONLY OF SIX CONNECTED
MODE: LARGEST
CHANNEL 1 SET FOR 5 g
CHANNEL 2 SET FOR 10 g
SERVO IN CONTROL
SERVO IN CONTROL ON ANOTHER CHANNEL
CHANNEL 2
CHANNEL 1
ACCELERATION g
10
5
1
10
100
1000
FREQUENCY - Hz

FIG. 2

APPLICATIONS (Continued)

c. Protection from Loss of Control Accelerometer Signal (Contd.)

This method is preferred because it is direct and operates on the actual acceleration magnitude as compared to other indirect methods which rely on the rate of change of the servo output for shutdown actuation. This indirect method is further complicated by the normal change in servo speed as a function of operating frequency.

d. Cross Axis Acceleration Limit

The ratio of acceleration in any direction normal to the driven direction to acceleration in the driven direction, is intended to be small. Resonant test items may induce unacceptably large values to this ratio. The ACS-6 allows accelerometers to be mounted with their sensitive axis normal to the driven axis. With these cross axis measuring accelerometers connected to any input channel other than number one on the ACS-6, the cross axis acceleration can be limited to any value of the above stated ratio from 1% to 1000%. For example, if the test specification required 20 g in the driven axis, the cross axis acceleration could be limited to any value from 0.2 g to 200 g. If the cross axis acceleration reached the preset value, the cross axis accelerometer would be switched to system control, depressing the acceleration at all other accelerometer locations as required to maintain the limiting acceleration at the cross axis measurement point.

e. Averaging Input

The ACS-6 can be used with the Unholtz-Dickie MAC-6C Averaging Control. Several acceleration channels (up to six) can be connected to the MAC-6C Averaging Control which in turn is connected to one of the channels of the ACS-6 Acceleration Control Selector. See Fig. 1 option.

PRESET CONTROLS

An internal calibration signal is provided allowing all controls to be set to the desired operating and limiting levels prior to operation of the system shaker. The Comparator Input Meter with easy reading scale facilitates setup adjustment.

VIBRATION METER

A precision meter calibrated in g pk units of acceleration with full scale ranges of 1, 3, 10, – – – 1000 continuously monitors the acceleration of any of the six inputs. The channel to be monitored is switch selected. The meter shows a constant acceleration when the channel being monitored has been automatically selected for system control, and the variation in acceleration when another channel has been automatically selected for control. A d-c output corresponding to the meter indication is available for recording.

PILOT LIGHTS

Lighted indicators identify which of the six input channels is selected for system control at any time during system operation. If front panel switch controls, which affect the system vibration level, are inadvertently changed during system operation, the standby pilot will light and system vibration will stop.

SPECIFICATIONS
ACS-6

1.0 Inputs

1.1 Acceleration Signal

1.1.1 Number of Inputs: Six. Any number from two to six shall be usable

1.1.2 Input Sensitivity:

10 mV pk/g pk

1.2 Frequency Signal

1.2.1 A d-c signal proportional to log frequency shall control switching detection speed

1.2.2 The d-c signal shall vary logarithmically for a frequency range of 5 to 5000 Hz

1.3 Input Impedance: Greater than 100 K ohms – all inputs

2.0 Output Acceleration Signal

2.1 Sensitivity: 10 mV pk/g pk on reference channel and on all other channels when weighting is set for unity

2.2 Gain: Unity. Input gated to output on reference channel and on all other channels when weighting is set for unity. Servo control metering and other instrumentation after the ACS-6 shall remain in calibration without adjustment.

2.3 Impedance: Less than 50 ohm

3.0 Operating Modes

3.1 Control On The Largest:

Whenever the acceleration magnitude in any operative channel shall rise to the preset level for that channel, that channel shall be switched automatically to the output.

SPECIFICATIONS, ACS-6 (Continued)

3.2 Control On The Smallest:

Whenever the acceleration magnitude in any operative channel shall fall to the preset level for that channel, that channel shall be switched automatically to the output.

4.0 Preset Acceleration Levels:

4.1 Reference Channel:

Shall be settable to any acceleration magnitude from 0.3 to 1000 g pk

4.2 Alternate Channels:

Shall be settable by calibrated locking dial to any acceleration magnitude within 0.01 to 10 times the reference channel magnitude except as limited by 0.1 to 1000 g pk. A switch position giving the same acceleration magnitude as the reference channel, independent of the locking dial position, shall also be provided.

5.0 Frequency Response: ±2%, 5 to 5000 Hz each channel

6.0 Dynamic Range: 90 dB based on unity weighting, a noise level of less than 0.03 g and a maximum input of 1000 g.

7.0 Switching Detection Speed:

Continuously variable as a function of operating frequency and optimized for maximum speed of response without "chatter" at the ripple frequency.

8.0 Indication Of Controlling Channel:

By front panel pilot lights

9.0 Preset Controls: An internal calibration signal and set up provisions, shall be included to preset each channel for the desired controlling acceleration magnitude without operation of the vibration shaker.

10.0 Meters:

10.1 Acceleration Meter:

10.1.1 Shall be switchable to any of the six input channels at all times

10.1.2 Full Scale Ranges:

1, 3, 10---1000 g

10.1.3 Meter Scales:

0 to 3 and 0 to 10 mirror backed

10.1.4 Scale length:

3.33 inches

10.2 Calibration Meter: For presetting per paragraph 9.0

10.2.1 Range Switching:

None required

10.2.2 Meter Scale:

Marked for REF-SM, CAL, REF-LG

10.2.3 Scale Length:

2.37 inches

11.0 Output Monitor Voltage:

11.1 Type: D-C output suitable for X-Y Recorder input. 1 volt for acceleration meter full scale value.

11.2 Switching: Any one of the six input channels shall be switch selectable for monitoring, regardless of the channel in control.

12.0 Interlocking: Front panel controls, which can inadvertently abruptly change the shaker vibration, shall be interlocked and cause the system amplitude servo to reduce the vibration to substantially zero if actuated. Pilot shall indicate interlock shutdown.

13.0 Circuitry: All solid-state, including solid-state switching and electro-optical control of switching speed.

14.0 Construction: Printed circuit, plug-in card

15.0 Physical: 5.25 H X 19 W X 12 D

16.0 Input Power: 105-125/210-250 VAC
50 to 60 Hz

UNHOLTZ-DICKIE CORPORATION

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Bulletin ACS-6-69
Printed in U.S.A.

III. Vibration Instrumentation

A wide range of instruments for measuring vibration is described in our General Instrument Bulletin. The most popular instruments are the Series 608 Charge and/or Voltage Amplifiers and the new Series 11 Charge Amplifiers. Both of these instruments are available with the exclusive Auto-Ranging feature. Range-Restorer, Model RR811 reestablishes the full dynamic range of the original signal after tape recording for visual analysis, X-Y recording, transmissibility or impedance plots, etc.

IV. Accelerometers

A line of piezoelectric accelerometers including subminiature as well as general purpose units with a wide range of outputs is available. These accelerometers feature extremely low case sensitivity, and freedom from thermal shock and base strain sensitivity. The cross axis sensitivity of these units is also exceptionally low.

V. Specialized Control Instrumentation

This is a group of instruments aimed at broadening the control capabilities of any basic test system. They include:

A. Controlling sine or random tests from the average of up to six accelerometers (MAC-6B). The unit operates using time sharing of the several input signals without time delays in the signal used for servo control thereby eliminating "hunting" or amplitude instability due to this cause.

B. Controlling sine tests from the highest or the weighted value of any of six accelerometers (ATC-6). This instrument also provides phase insensitive sine averaging without added time delays to the signal controlling the servo.

C. Programming sine tests within an envelope defined by any combination of 5 acceleration or displacement levels within a 100 to 1 range (AP-5).

VI. Random Accessories

Available for any vibration test system in an elementary 14 channel system (RV100) or the more sophisticated 40 channel system (RV500A).

VII. Vibration Slip Tables

Available in a wide variety of sizes for large and/or heavy loads. An exclusive feature is the multi-piston positive displacement oil pumping system to insure equal oil film at multiple orifices on the slip plate bearing surfaces.

VIII. Combined Shaker and Slip Table Seismic Base - for above floor mounting on air springs.

Since most test equipment is tailored for specific applications, we would appreciate an opportunity to provide additional information on equipment in the specific areas of interest.

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